valuable as a source of general information on the subject.

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SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 201st meeting of the society, held in the Cosmos Club, on Wednesday evening, February 26, the following papers were presented:

Regular Program

Evidences of Recent Volcanic Activity and the Glaciers of Mt. Hood, Oregon: A. H. SYLVESTER.

Mt. Hood, the highest mountain in Oregon and one of the most beautiful of the ice-covered extinct volcanoes of the Cascade Range, lies on the crest of that range about 20 miles south of the Columbia River. Its elevation is 11,225 feet. About two thirds of its crater remains, the southwest side being broken away.

The evidence of field observations and the new topographic map made by the writer last summer point to a very extensive glaciation at some former period, and to another less extensive advance in comparatively recent times.

An enormous mass of morainal material covers the southwest flanks of the mountain and nearly fills three of its large canyons. This was probably derived from the cutting away of the crater by the early glaciation. The Zigzag and White River glaciers now head against the inside of the north wall. They have cut away the old crater floor and exposed the volcanic neck or plug which now stands a prominent feature in the center of the ruined crater and is known as Crater Rock.

A section exposed in White River Canyon by the cutting of the present streams through the morainal filling shows two layers of drift separated by a layer of soil and logs in place, and ten or twenty feet of fossil ice underlying all. There are eight glaciers of fair size on the mountain. On the whole, they are probably receding, but owing to several recent heavy winters there now appears to be an advance.

The Zigzag and White River glaciers are exceptions to this rule, because of volcanic heat. Their lower ends are disintegrating and opposite Crater Rock, the point of greatest volcanic activity, the Zigzag is partially and the White River wholly cut in two.

On August 28, 1907, in addition to the usual steam, smoke was seen issuing from Crater Rock and at night a glow was observed. The next day the White River was trebled in volume without other warrant than the mountain's internal heat.

No alarming symptoms have been observed since.

Physical Features of Peru: GEO. I. ADAMS.

Peru is generally considered as containing three regions: the coast, the sierra and the montaña or forest. These regions differ climatically, the coast is arid and agriculture is carried on by means of irrigation. The sierra has a moderate rainfall and being an elevated region evaporation is great, so that the climate is semi-arid. The forest region has a heavy rainfall and is covered with a tropical forest.

The coast region is a narrow belt. In the northern, south-central and southern portions there are coastal plains. The extent of these plains was shown for the first time on the maps accompanying Mr. Adams's reports of his reconnaissance of the coast, published as bulletins of the Corps of Engineers of Mines of Peru. Between the northern and south-central plains and likewise between the south-central and southern plains the mountains descend to the sea. Between the southern plains and the sea there is a range of coast hills. The coastal plains are occupied by Tertiary formations.

The division between coast and sierra is dependent upon elevation, not upon topography, and corresponds with the limit of general annual rainfall excepting to the northward, where the rainfall extends over a portion of the coastal plains in the region of the Gulf of Guayaquil. The approximate limit of the annual rainfall is shown on Mr. Adams's maps.

The sierra consists of Cordilleras and inter-Andean valleys. The higher regions are spoken of as *punas*. Agricultural products of the sierra which are grown at moderate elevation and for the most part independent of irrigation are corn, barley and potatoes and similar crops. Descending the rivers toward the Amazon the valleys are fertile and productive, but upon entering the forest agriculture is meager because of the dense growth of vegetation which has not yet been dominated.

Ralph Arnold,
Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

The forty-seventh regular meeting was held in the seminar room of the Bureau of Plant Industry on Saturday evening, February 29, at 8:30 o'clock. Dr. George G. Hedgcock presented a paper entitled "Crown-gall of the Apple."

A summary was given of observations and studies on the apple crown-gall conducted during the past five years with large experiments in nursery plots and orchards containing nearly 100,000 trees; a part of this work was carried on under Dr. Hermann von Schrenk, at the Mississippi Valley Laboratory, St. Louis, Missouri.

The term "crown-gall" as applied to the abnormal growths on the apple tree, includes a number of forms. The two forms known as the "hard" and "soft" crown-gall are fairly distinct from the hairy-root forms. The latter may be considered for the present as a separate disease.

The crown-gall of the apple occurs in both the hard and soft forms in this country wherever apple trees are grown to a large extent; it is present on seedlings, grafted and budded trees; both forms are closely related to wounds and the formation of callus. Only wounded trees become affected with the disease, indicating that it may enter through the resulting callus, possibly through stimulation by a parasitic organism. The soft form of apple crown-gall is contagious to some extent, and is identical with the disease on the stone fruits, raspberry, blackberry, dewberry, rose, pear and possibly chestnut and walnut. The hard form differs in texture and appearance from the soft, and is either not at all, or only slightly, contagious. It may yet be proved that in case of the hard form, the apple tree has been able to resist and largely overcome the disease by healing processes which lower the vitality of the parasitic organism causing it, and that the two forms have one and the same cause.

The disease is always injurious to the apple tree in case of the soft form, but the effect in case of the hard form may not always be injurious except where the disease encircles the tree, interfering with the circulation. In milder forms the tree may overcome the disease.

Certain varieties, as Wealthy, Wolf River, Yellow Transparent and others, are subject to the hard form of the disease. On the other hand, certain varieties, as Maiden Blush, Rambo, Red June, Minkler and others, are more subject to the soft form of the disease. The results *from experiments* indicate the value of selecting scions from healthy trees. Preventive and curative measures were suggested for the control of the disease.

This paper was illustrated with lantern slides.

Mr. W. F. Wight presented a paper entitled "Some European Botanic Gardens." The paper consisted of a series of illustrations taken by the speaker, showing scenes in nearly all of the leading botanical and public gardens of Europe, and were explained in detail by him. An account was also given of the work and administration of the Kew gardens.

Haven Metcalf,
Corresponding Secretary pro tem.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 647th meeting was held March 14, 1908, Vice-president Day in the chair.

Professor Frank H. Bigelow, of the U. S. Weather Bureau, read a paper entitled "Evaporation Studies at Reno, Nevada, and at the Salton Sea, Southern California."

In the preparation for an extensive campaign on the evaporation of water over large

lakes and reservoirs, in an effort to supply data requested by the constructing engineers of reservoirs and irrigation projects, it has been decided to use the Salton Sea, southern California, on account of the intense evaporation there prevailing under conditions which are favorable because of the small amount of precipitation and inflow from the rivers in that region. A comparison of several careful studies on evaporation in different parts of the world shows that the formulas result in very different constants, depending apparently upon the local conditions. It seemed proper to attempt to discover the cause of this discrepancy in order to plan the Salton Sea work more carefully. We set up a temporary station at Reno, Nevada, at the double city reservoir, the two reservoirs being 400 by 800 and 300 by 500 feet, approximately, having a large irrigated alfalfa field to the west, in the direction of the Truckee Valley, and a dry field to the east in the direction of Sparks. The meteorological conditions were very favorable, and observations continued from August 1 till September 14, 1907. Five towers, 40 feet high, were erected: No. 1 (east) in the dry field, No. 2, No. 3 (center), No. 4, in order, on the bank of the reservoir, No. 5 (west) in the alfalfa field. Twenty-nine pans were set up, five six-foot pans on the ground or in the water, and twenty-four two-foot pans on the stages of the towers, ten feet apart, or on the platforms leading to the pans in the water. The observations were made regularly at the hours, 1 A.M., 5 A.M., 8 A.M., 11 A.M., 2 P.M., 5 P.M., 8 P.M., and consisted of dry and wet bulb temperatures in the air near the pans, also one half an inch above the water in the pans, the surface water temperature by means of a floating raft, the depth of the water in the pans at each hour, the anemometer at tower No. 2 (east bank), and comparative Piche evaporimeter readings at tower No. 2 on six stages. The results may be briefly summarized as follows: (1) No difference appeared in the evaporation on account of the size of the pans. (2) The wind effect is given by the formula

$$E_2 = E_1(1 + Aw) = E_1(1 + 0.0175\ w)$$

where E_1 is the evaporation without wind and w is the velocity in kilometers per hour, E_1 being the evaporation in centimeters. (3) The evaporation diminshed from a maximum down the center tower to the water surfaces, something like the amounts indicated by the coefficients following:

Towers.	(5)	(4)	(3)	(2)	(1)	Height.	
						Meters.	Feet.
Maximum	.043	.043	.043	.043	.043	∞	∞
Pan (7)	.039	.038	.036	.037	.039	12	40
Pan (5)	.037	.035	.032	.035	.037	6	20
Pan (3)	.035	.031	.026	.030	.034	3	10
Pan (1)	.025	.024	.017	.023	.029	0	0

The adopted formula is:

$$E = Cf(h)e\frac{de}{ds}(1 + Aw),$$

where e is the vapor pressure of the air at the dew-point temperature, de/ds the rate of change of the vapor pressure per degree temperature centigrade. $Cf(h)$ the variable function. As in the table, the lines for $Cf(h)$ at each pan become asymptotes to the maximum coefficient (the extreme desert station) and they express a complex function of the diffusion and mechanical mixture of fresh streams or evaporating vapor. The vapor blanket lying over a lake retards evaporation in this manner, and the location of a pan in the blanket is of prime importance. Note the effect of the alfalfa field on pan (1), tower No. 5 (0.025 which is depressed). We propose to erect towers in the Salton Sea, and shall endeavor to discover the function $Cf(h)e$, which undoubtedly has a small diurnal period and probably an annual period. To integrate this function over a lake surface is very difficult, and to pass abruptly from an isolated pan to a lake is not permissible.

The papers on the Reno work will appear in the *Monthly Weather Review*.

The second paper of the evening was presented by Dr. J. W. Spencer, under the title "Soundings under Niagara Falls and in the Gorge."

This very interesting paper gave a description of the application of sounding methods

to an unusual subject, by which the physical features of the gorge were brought to light, thus determining what work the Falls of Niagara had accomplished at each point in their recession. Apart from the soundings in the vicinity of the crossing of the little steamer *Maid of the Mist,* and at the cantilever bridge, none had been previously undertaken, so that even the depth of the river and its characteristics in front of the American Falls, and nearer the Canadian Falls, as well as in the gorge generally, were not known. The whirlpool was a mystery, and it was thought impossible to sound under the falls themselves.

For a mile and a half below the falls, the soundings in the navigable basin were made from the steamer *Maid of the Mist,* and from the bridges. At the whirlpool and below, a cable was extended across the gorge, and soundings were made from it. Inside and beyond the end of the gorge the soundings were made from a small boat, as also in a most dangerous section below the whirlpool. As the currents were violent, resort was made to self-registering hydrostatic tubes (the Tanner-Blisch), so that the depths were obtained. At the falls a suitably designed buoy was used, in which were placed two separate self-registering tubes. This was repeatedly sent over the falls and recovered, so that results were obtained which were surprising. In one instance the buoy struck the fallen rock in the falls (as shown by the marks on the lead shoe) at a depth of only 72 feet. In the center of the river, farther down, the depth was from 84 to 100 feet, but a lateral channel reached 192 feet in depth. The effective excavating power is thus found to be about 100 feet below the surface of the river. The greater depth resulted from the previous lower river surface. The line of deepest soundings repeatedly showed 186 feet to near the cantilever bridge, about two miles below the falls. Under the bridge the maximum depth is 85 feet (found by engineers for the railway company). Here also borings had been made beneath one of the piers, showing a refilled channel to a depth of 185 feet. The descent of the whirlpool rapids is 51.5 feet. A section across it shows a maximum depth of 102 feet, but in the river course itself a depth of 126 feet was obtained, but it is possible that one from 8 to 14 feet more may occur just beyond. Thus, from near the falls to the whirlpool, the floor of the cañon is found to reach 87–90 feet below the level of Lake Ontario.

Just below the whirlpool great changes occur in the gorge, and at a quarter of a mile farther the maximum depth was found to be 99 feet, or to a plane 59 feet below the level of Lake Ontario. As the Whirlpool Rapids are produced by the fallen rocks refilling the original channel, so also Foster Rapids are due to the same cause. Other measurements were made. Those a short distance within the gorge were found to reach 150 feet, and others some distance beyond its termination showed a narrow inner channel to a depth of 183 feet, or 181 feet below the level of Lake Ontario. These discoveries were hitherto absolutely unsuspected.

These results show that the narrow channel was formed when the level of Lake Ontario was about 180 feet lower than now, at the time when the Niagara was draining only the Erie basin and not the four Upper Great Lakes. They show that the falls were once very much higher than now, and that the last cataract, of the three which composed them, was alone over 300 feet high, and the whole aggregated over 500 feet.

The soundings also complete the proof that the falls were located just above Foster Flats, or about three miles within the end of the gorge, when the volume of the Niagara was vastly augmented, owing to the addition of the waters from the three highest lakes, which now took place. Again, the soundings at the falls bring to light the fact that the modern cataract is not so high as it was a few hundred years ago, before the completion of the Whirlpool Rapids.

These investigations were made under commission of Dr. Robert Bell, the head of the Geological Survey of Canada.

A full discussion of the important significance of these results is soon to be published

by the speaker under the title "Evolution of the Falls of Niagara."

R. L. FARIS,
Secretary

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

THE 176th meeting was held in the main lecture room of the chemical laboratory, Wednesday, February 12, 1908, at 7:30 P.M. Professor Collier Cobb addressed the society on "The Cause of Earthquakes in the Light of Recent Earthquake Action." The lecture was fully illustrated with lantern slides.

A. S. WHEELER,
Recording Secretary

DISCUSSION AND CORRESPONDENCE

SCHAEBERLE, BECKER AND THE COOLING EARTH

TO THE EDITOR OF SCIENCE: Professor Schaeberle is certainly a bold man when, in your current number (March 6, 1908, p. 392), basing himself on his method of observing stellar temperatures, he would upset modern astronomy with one hand, and make the sun the center of the sidereal cosmos, and with the other would upset most modern theories of geological climate! I hardly think that Borrell, in the current number of the *Journal of Geology,* Huntington, in the current volume of the Geological Society of America, or most of the speakers at the Geological Congress in Mexico, will at all agree that Manson's hypothesis is "demonstrated as a true theory"! They will agree with Chamberlin's strictures. But one can not yet go into further criticism, save to urge those of your readers who are neither geologists nor astronomers not to accept Professor Schaeberle's *ipse dixit,* but rather await the demonstration which he promises "later on."

The object of this letter is rather to call attention to the bearing which his work has on that of Becker[1] on the cooling earth. Since Becker has kindly undertaken what I had thought to do myself, when I had just a few more facts, a few comments as to the applicability of his conclusions may be ventured.

[1] SCIENCE, February 7 and March 8, Vol. 27, pp. 231, 232, 392.

Though Becker's concise method of deriving his formulæ (2) is not beyond criticism mathematically, the same may be derived from Riemann's and Byerly's[2] more general and rigid treatment. But Becker's discussion of his formula obscures a most important limit to its application, to wit, the *temperature must remain constant at the surface of the cooling body, which he assumes to be the rock surface.* Otherwise the solution applicable is that given by Byerly (*loc. cit.*) on page 88, following Riemann.

If we assume the temperature of the atmosphere at the surface to have varied appreciably, and especially if we assume that its temperature depends on that of the earth, as Schaeberle says is largely the case (that two thirds of its temperature is due to interior heat), Becker's solution is inapplicable in the form he gives it. In fact, if two thirds of its heat comes from the ground *now,* originally, at the time "hell froze over" and the waters above the earth were separated from those under, must not the temperature of the atmosphere near the earth have been much hotter and much nearer that of the freshly consolidated rock than Becker assumes? Must not the waters of the ocean have been then largely up in the air and so the blanketing effect and the atmospheric pressure much greater? If so, Becker's conclusions are utterly useless. For his fundamental formula may be thus worded:

$$\left(\frac{V = \text{original excess of surface rock temperature over atmospheric}}{\text{present geothermal gradient} - \text{original gradient}}\right)^2 = 22/7 \times \text{diffusivity} \times \text{time elapsed.}$$

Now, Becker estimates the numerator as something like 1,300° C., apparently assuming this as the fusion point of a fairly silicious rock, and the atmospheric temperature at 0° C.? But all my work with grain indicates lower consolidation temperatures for the acid than the basic rocks, the former being in the state of aqueo-igneous fusion of a sugar syrup at 150° C. Moreover, as Day and Co. have shown, quartz will not crystallize above

[2] "Fourier's Series and Spherical Harmonics," p. 84.